Electronic supplementary information (ESI)

Continuous process of cellulose dissolution and transesterification reaction catalysed by ionic liquid in twin screw extruder

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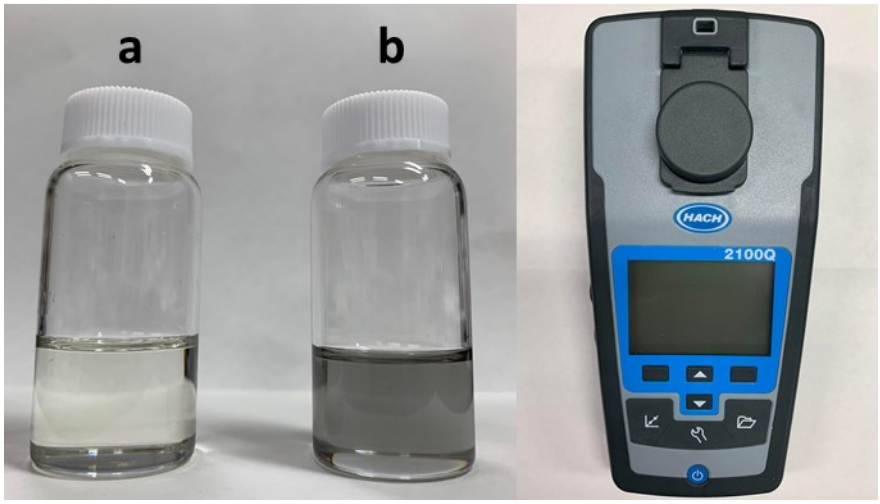


Fig. ES1 Turbidity measurement samples (a: without Fe_3O_4, b: with Fe_3O_4) – (left), 2100Q Portable Turbidimeter equipment – (right).

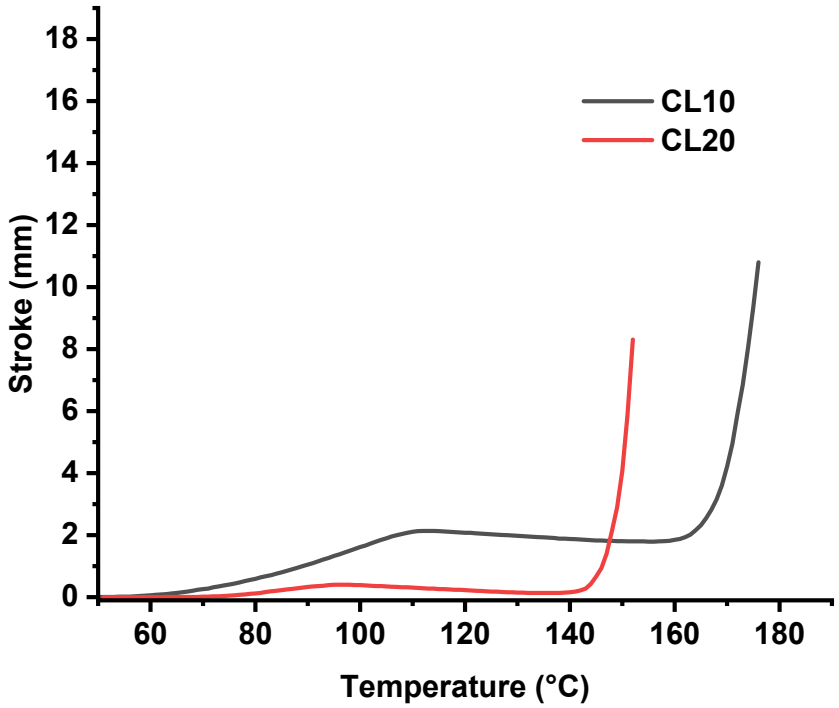


Fig. ES2 Stroke-temperature graph of cellulose laurate samples.

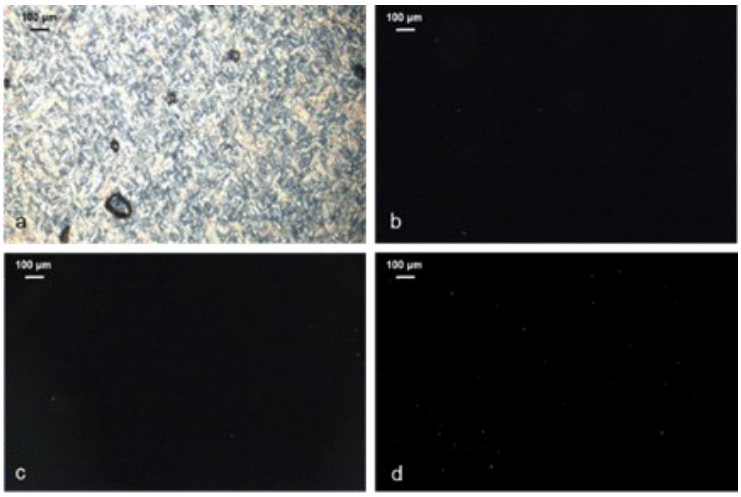


Fig. ES3 Optical microscopy images of MCC solution of different concentration in EmimOAc/DMSO (1/3 g/g) extruded at different temperatures (n = 60 rpm, Q = 6 g/min): (a) Conc = 20 wt%, T = 100 °C; (b) Conc. = 10 wt%, T = 100 °C; (c) Conc = 10 wt%, T = 80 °C and (d) Conc = 10 wt%, T = 60 °C.

Fig. ES4 Optical microscopy images of MCC solution in EmimOAc/DMSO (1/3 g/g) extruded at feed rate of 30 g/min (Conc = 10 wt%, T = 80 °C, N = 60 rpm)

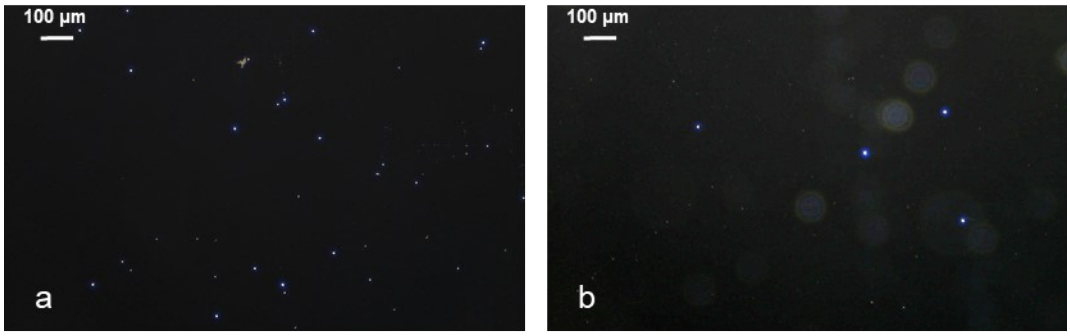


Fig. ES5 Optical microscopy images of MCC solution in EmimOAc/DMSO (1/3 g/g) extruded at different screw speed (Conc = 10 wt%, T = 80 °C): (a) N = 120 rpm; (b) N = 180 rpm.

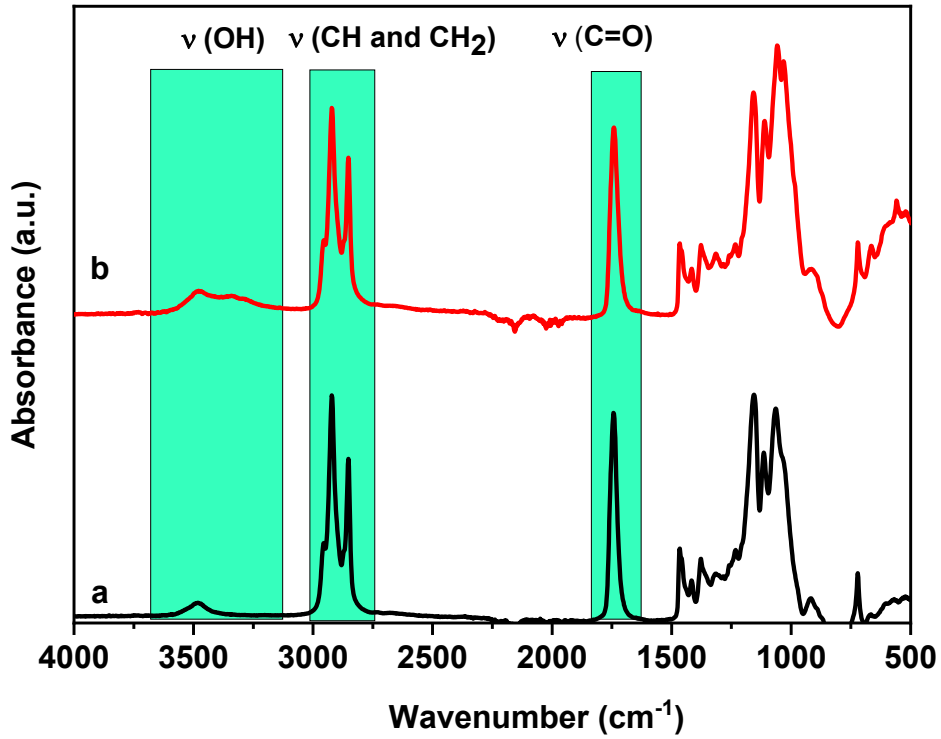


Fig. ES6 ATR-FTIR spectra of CL10 (a) and CL20 (b).

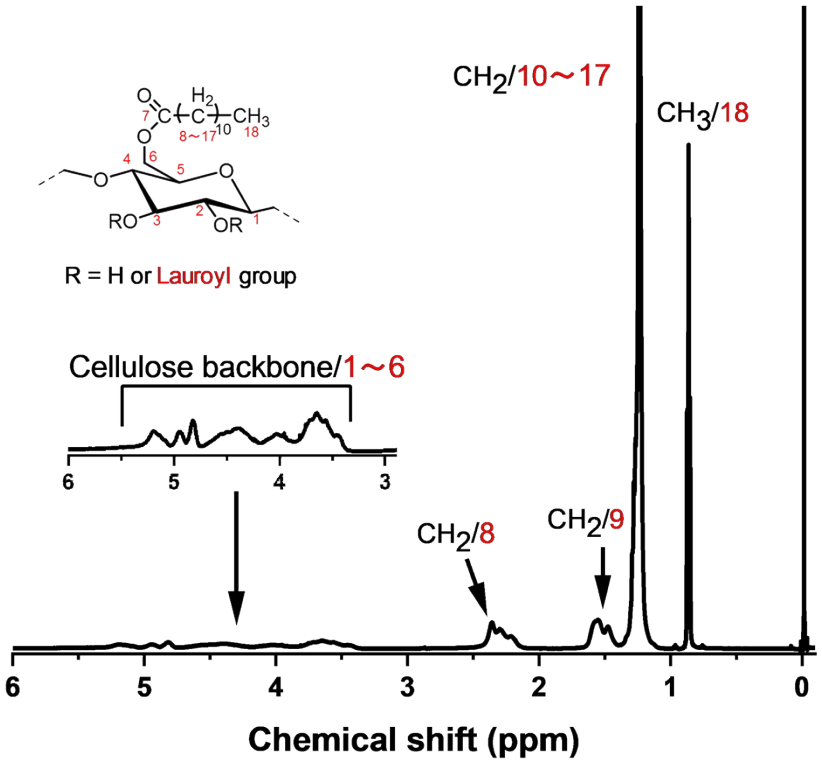


Fig. ES7 ^{1}H NMR spectrum of cellulose laurate (CL10) in $CDCl_3$.

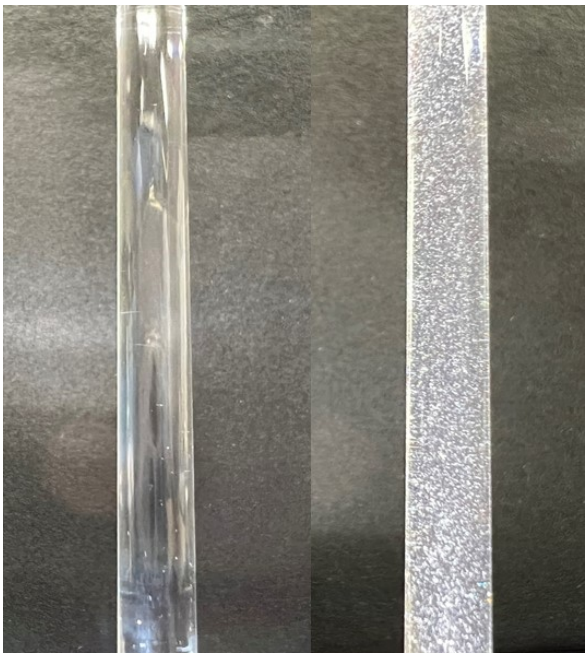


Fig. ES8 Cellulose laurate samples solubility in $CHCl_3$ (concentration 10 g/L): CL10 (left) and CL20 (right)

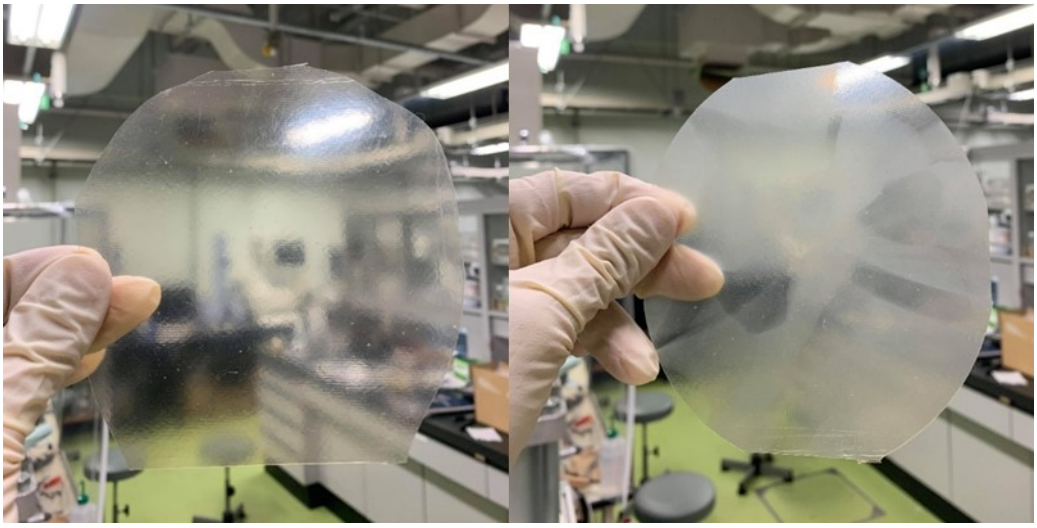


Fig. ES9 CL films prepared from CL10 (left) and CL20 (right)

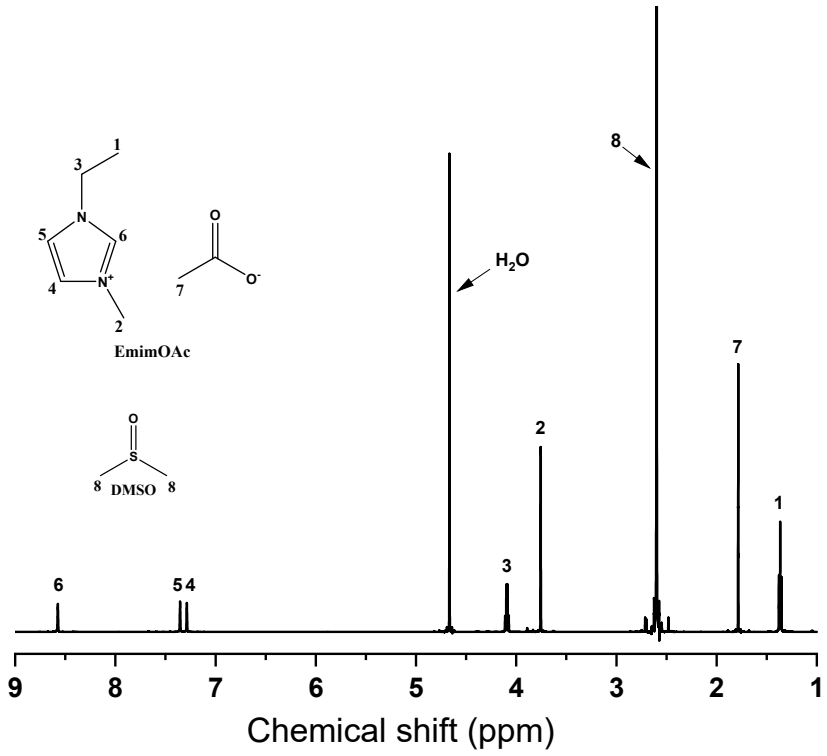


Fig. ES10 ^{1}H NMR spectra of fresh EmimOAc/DMSO (1/3 g/g) mixture in D_2O

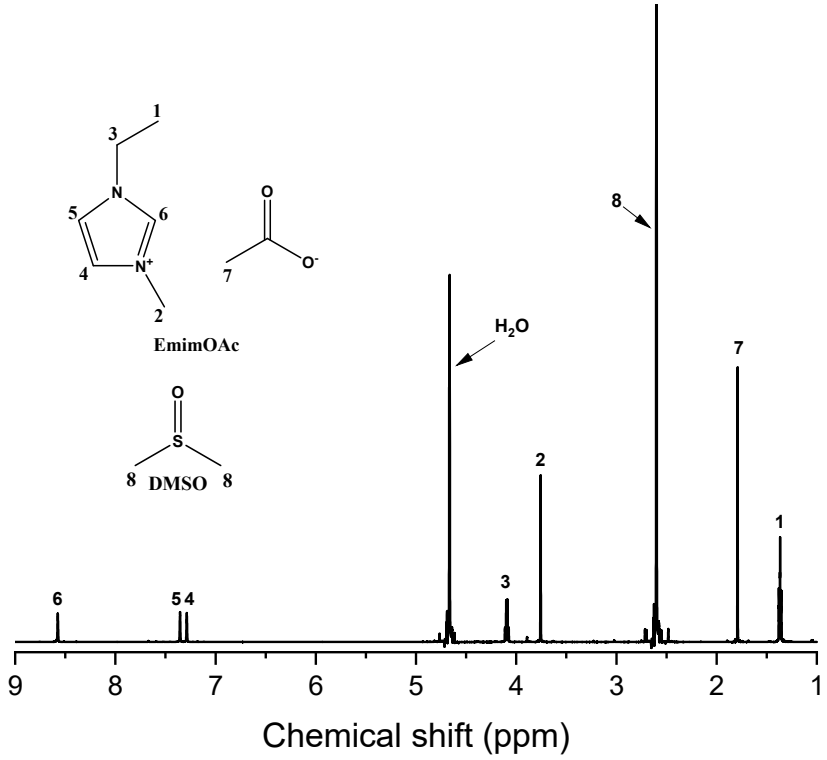


Fig. ES11 ^{1}H NMR spectra of recovered EmimOAc/DMSO (1/3 g/g) mixture in D_2O

Table ES1
Experimental design for MCC dissolution and RTD measurements experiment

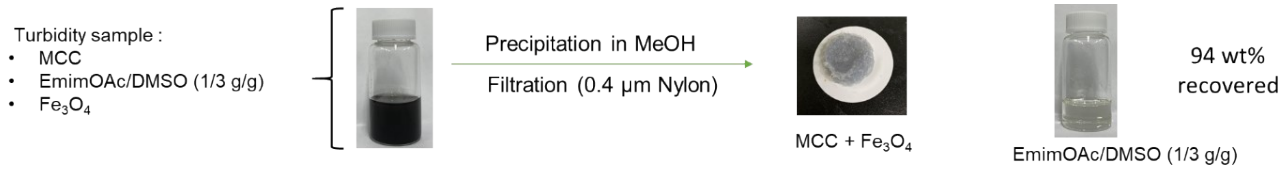
Run	MCC conc wt%	Feed rate g/min	MCC g/min	EmimOAc/DMSO g/min
1	10	6	0.60	5.40
2	10	30	3.00	27.00
3	20	6	1.20	4.80
4	20	30	6.00	24.00

MCC dissolution conditions: EmimOAc/DMSO (1/3 g/g); 60 rpm; 80 °C.

Table ES2
Thermal properties of cellulose laurate samples of different DS

Sample[a]	DS_{main}	$T_{d,10\%}$ (°C)	T_s (°C)	T_{fb} (°C)	T_{off} (°C)
CL10	2.48 ± 0.05	364	110.3	156.0	172.9
CL20	2.67 ± 0.04	375	96.4	140.1	151.1

[a] Reaction conditions: 10 wt% MCC (CL10) and 20 wt% of MCC (CL20) in EmimOAc/DMSO (1/3 g/g); vinyl laurate 3 eq./[AGU]; 60 rpm; 80 °C.



Scheme ES1: Recovery of EmimOAc/DMSO (1/3 g/g) mixture after turbidity measurements

E-factor calculation

The E-factor was calculated using Equation 1 and the method described by (Onwukamike et al., 2019)[1]

CL10 synthesis

Raw materials used in this study:

Since we used the continuous flow, we calculate the amount of each reaction component and product used in our process per minute of time. The weight of each component was:

Cellulose (MCC) = 3.00 g, EmimOAc = 6.75 g, DMSO = 20.25 g, Vinyl laurate = 12.57 g (3 eq/[AGU])

Total weight of raw materials = 42.57 g

Obtained DS: 2.48

Weight of obtained product = 9.43 g (yield 83%)

E factor = (Weight of raw materials - Weight of product) / Weight of product

E-factor = (42.57 – 9.43) / 9.43 = 3.5

Equation 1: E-factor = (Weight of raw materials - Weight of product) / (Weight of product)

[1] K.N. Onwukamike, S. Grelier, E. Grau, H. Cramail, M. A. R. Meier, *ACS Sustain. Chem. Eng*., 2019, **7**, 1826–1840.